VOLUME 116 NUMBER 6 JUNE 1960

THE BRITISH VETERINARY JOURNAL

A Monthly Review of Veterinary Science

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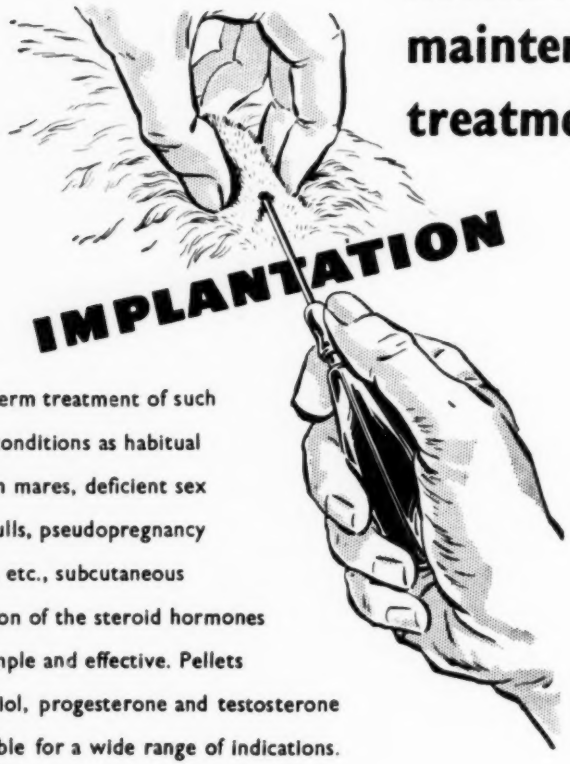

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The British Veterinary Journal

JUNE 1960

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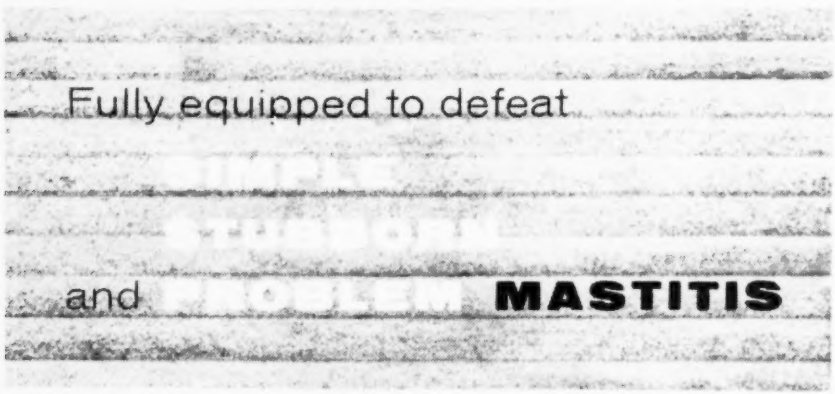

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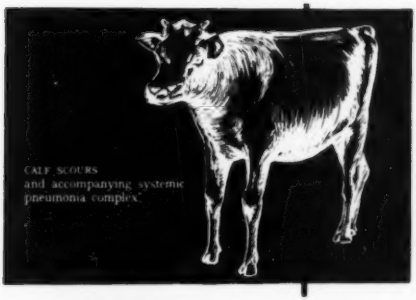

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Vol. 116 **June, 1960** **No. 6**

EDITORIAL

SPELLS AND CHARMS

When Pontius Pilate asked " What is truth ? " he propounded one of the most extraordinary enigmas that the world has known. Pilate may have construed these words with due thought and care and with some specific purpose in view. They may have crossed his lips by the whim of chance. It may be that, in great dilemma, he was at loss for other words, for his conscience was sorely troubled. Pilate's difficulty was not eased when the great Teacher made reply " Everyone that is of truth heareth my voice." This adds another facet to the question, for this sage answer implies that those who hear truth should be attuned to receive it and recognise its worth.

First impressions would lead one to suppose that truth was factual and could be defined with ease. On second thoughts and after full consideration the problem does not resolve, for what may represent truth one day may prove to be erroneous on the next. One must come to the conclusion that truth is relative and may vary in interpretation according to time, circumstances, the state of knowledge and the receptive power of the audience.

The only logical way in which one can surmount the difficulty is to say that truth is regulated according to the reaction and sensitivity of one's conscience, the mental poise of those to whom it is delivered and the information which is available at the time.

Most men, when they review the past, must have recollections of occasions when, with all sincerity, they have made statements which they were convinced represented the truth and were accepted as such and yet, in the light of the new information which has become available, they could not sustain today. It is easy to jeer and scoff at some of the strange medical beliefs which were extant in the mediaeval age and are prevalent even in more recent times. In the light of modern knowledge they appear to be completely absurd and savour of the Charlatan, the Witch Doctor and old wives' tales. This attitude is unkind, for truth is relative to the information on which it is based and it is feasible that those who follow us, in say a hundred years' time, may be tempted, and with

some justice, to relegate modern savants to the same grade. If it were possible to confront the ancient alchemists, apothecaries and astrologists with some of the achievements of contemporary science they would gasp with wonder, for the works of modern man would be far beyond their comprehension. No doubt they in turn would judge us as we do them. All knowledge has been built up from small beginnings just as many a great business empire has been born in the modest corner shop of a quiet city street. In both cases those who strove to expand the fount of knowledge and endeavour in the pristine days had no great fund of experience or factual technical assistance at hand to smooth their way. They had to search and probe and find things out by the crude methods of trial and error. Many of the things or methods which they accepted in those early days and were found "to work" would bring a shudder of horror to the members of a modern, stream-lined business executive or scientific staff. If we examine these things in retrospect and with an open mind one thing stands out prominently. The crude untutored methods served their purpose. They sufficed for they were relevant to the desires and expectations of the times and from amongst the mêlée or farrage of ideas and myths there was a modicum of substantial fact on which to provide a basis for successful development in the future.

Truth is always strange and often it is intriguing, and the passage of years adds enchantment which can be appreciated by those whose enquiries derive from a philosophic bent. The history of the medical art is one of the most fertile fields in which a philosopher can delve. Its foundations are wrapt in mystery and magic. The majority of those who practised the art in ancient times must have been convinced of the rectitude of their beliefs and their patients must have accepted them as truth. Even in modern times there are men who dig deeply into the realms of mystery and magic in their efforts to relieve and cure disease in man and animals, and apparently with some success.

Science has made great advances since the days when charms and tokens were used by every physician and, bolstered by new found knowledge, we are apt to scoff at and deride all those things which are without material proof. In search of explanation we have recourse to psychology, a subject which is in its infancy and almost as inexplicable as were the cults which were practised in other days.

Superstition will always weave her airy dreams until the mystery of all the world is solved. Truth is always strange and we should explore every avenue before we reject or confirm. In this journal we present a most interesting article anent some of the strange therapeutic and other procedures which held sway for many centuries. In some parts of our land they are practised today. Reading this article may provide a pleasant interlude from the spate of scientific material which floods the modern world.

THE AMULETIC AND TRANSFER CHARM CURE OF CATTLE AND HORSES

By T. D. DAVIDSON

Until late into the eighteenth century the hazards of animal husbandry were formidable. Winter feeding, always a problem, relied on locally grown food and, since good harvest yields were the exception rather than the rule, the fear of food shortage and near famine was constantly before the farmer. Under these conditions sickness, disease and epidemic outbreaks were almost inevitable.

In the absence of all but the most elementary knowledge of veterinary science and the complete ignorance of all methods of hygiene, sickness or disease whose cause was not immediately apparent was attributed to supernatural forces, that is, witchcraft, the fairies and the evil eye. In consequence there was an eager acceptance and belief in the use of all manner of superstitious practices for the relief of illness and to obtain security from epidemic outbreaks.

Logically it would seem appropriate to examine the various charm cures and amulets used in relation to the diseases they were supposed to cure. Such a classification, however, is not possible, as most of them were used quite indiscriminately, either as simple amulets, or the combination of several different amulets and charms for both cure and protection. Therefore, it is difficult to arrange them in orderly sequence, but since their employment derives in the first instance from the belief in sympathetic magic they can conveniently be grouped into two main classes: amulets governed by the law of sympathy, i.e. similarity and imitation, and charm cures governed by the law of transfer. A further broad simplification may be made by subdividing the first group into natural amulets, comprising rock crystal balls and pebbles, perforated flints, but predominantly naturally holed, grooved and water-worn stones and pebbles, and manufactured amulets, consisting in the main of manufactured objects used singly or in conjunction with one or more objects, as, for example, coins and prehistoric artefacts in association with special water, rowan tree twigs made into crosses and bound with coloured wool and thread, usually red.

Very often the words charm and amulet are interchangeable, but although they are closely related, there is this fundamental difference between them: charms are expendable and can operate at a distance, amulets are permanent and operate in a direct way, usually by contact.

Natural Amulets

One of the most extensive groups which by usage and distribution appear essentially Scottish, consists of rock crystal in the form of balls, round and ovate pebbles, which were found, distributed quite commonly, throughout Britain mainly in association with Iron Age interments and Anglo-Saxon graves. At first they were thought to have had some magical significance, but accumulated evidence has shown that their function was purely ornamental. Not until about the sixteenth century do we find references to their use as enchanted stones and incorporated

into ornamental settings, as amulets for the protection and cure of disease in animals.

Edward Llwyd[1], keeper of the Ashmolean Museum, Oxford, writing in 1699 from Linlithgow, in Scotland, says that in the Highlands " they have the *Ombriae pellucidae*, which are crystal balls or depressed ovals, which were held in great esteem for curing of cattle ; and some on May Day put them into a Tub of Water, and besprinkled all their cattle with the water to prevent being Elf-struck, bewitched etc." According to Vallancey[2], in Ireland rock crystal pebbles known as " water-stones " were thrown into water to give it a medicinal virtue.

A ball of rock crystal which was in possession of the Marquess of Waterford, Ireland, was eagerly sought after by farmers in order to be placed in a running stream, through which the diseased cattle were driven backwards and forwards, or to be placed in the water given them to drink[3]. Another, " of shining crystal about the size of a large marble " was dipped into water once a year, and the water given to farmers for their cattle."[4] Dalyell quotes a letter to the Rev. Robert Wodrow in which there appears the following passage, " Leig- being a great pice of the clearest of cristall, in forme ane halfe ovall, near to the bigness of a littel hen eage: but I find it being of great use for peple that has coues, being good for many diseases, they sik great monies for it, as forty pounds Scots."[5] A common name in the Highlands for rock crystal balls used as amulets was *Leug, Loug,* or *Leigheagan,* and a typical example, the MacLean Loug mounted for suspension, is shown in Fig. 1.1. Shaw, in his *Gaelic Dictionary,* was probably referring to such a ball when he records " priests keep it to work charms by and water poured upon it at this day (1780), is given to cattle against diseases."

In an MS written between 1749-80 concerning a crystal ball known as the *Clach-na-Brataich* or Stone of the Standard, we learn that " they ascribe to this stone the Virtue of curing Diseases in Men and Beasts, especially Diseases whose causes and symptoms are not easily discovered ; and many of the present generation in Perthshire would think it strange to hear the thing disputed."[6]

It was particularly effective " in stopping the progress of an unaccountable mortality amongst cattle." On the last occasion on which it was used, between 1822-1830, it was dipped with much gravity by the chief of the clan Donnachaidh of Struan, Perthshire, in a great china bowl filled with water from a " fairy " spring, after which the water was distributed to a number of farmers who had come great distances to obtain it for the cure of cattle and horses.

A similar but slightly smaller amulet, the *Clach Dearg* or Stone of Ardvoirlich, is a ball of rock crystal mounted in a setting of four silver bands, with a ring at the top for suspension. Farmers came from widely different parts of the countryside to get a supply of water in which the amulet had been dipped. The belief in the virtue of this amulet for curing diseased cattle continued well into the latter half of the nineteenth century. Various ceremonies had to be observed by those who wished to benefit by its healing power. The person who came for it had to draw the water himself, and bring it into the house of Ardvoirlich in a vessel into which the amulet was to be dipped. A bottle was filled and carried away, but

during its carriage home it must not touch the ground not to be taken into any house by the way, otherwise the magical virtues would leave the water.[7]

The Keppoch Amulet was "an oval of rock crystal, about the size of a small egg, fixed in a bird's claw of silver, and with a silver chain attached, by which it was suspended when about to be dipped in water. The following was chanted while the amulet was being dipped:—

Let me dip thee in the water,
Thou yellow beautiful gem of Power!
The water of purest ware,
Which (Saint) Bridget didn't permit to be contaminated.
In the name of the Apostles twelve,
In the name of Mary, Virgin of virtues,
And in the name of the High Trinity
And all the shining angels,
A blessing on the gem,
A blessing on the water, and
A healing of bodily ailments to each suffering creature.[8]

The reference here to the Celtic Brigit or Bridget derives from the well *Tobar Bhride* (Bridgets' Well) near Keppoch, from which the water into which the amulet was dipped had to be taken. St. Bridget was specially invoked for the protection of sheep and cattle and she is often depicted in Christian art holding a cow, standing by a barn or with milk pails; one of her titles was "Christ's milkmaid."

An ancient Celtic brooch belonging to the Campbells of Ballochyle, Argyll, and dated approximately to the latter part of the sixteenth century, consists of a silver gilt setting with a rock crystal in the centre — see Fig. 2. Even to a late period it had been used as an amulet against witchcraft and disease both for men and cattle. The amulet was dipped into water or whatever potion was prepared for the sick animal.[9] Pennant mentions having seen a ball of rock crystal, or a "crystal gem" as he prefers to call it, mounted in silver in the possession of Captain Archibald Campbell of Glenlyon which was known as the *Clach Bhuai* or Powerful Stone. It appears to have been used in the cure of human as well as animal diseases, people coming from distances over a hundred miles for water in which the amulet was dipped. As in the case of the *Clach Dhearg* the water had to be carried to the amulet by the people wanting the cure. To make the water in which it was dipped sufficiently medicinal and effective, the stone, during the process, had to be held in the hand of the laird.[10] Finally an oval water-worn pebble of crystal formerly kept over the lintel of the byre door at Cachladhu croft near St. Fillans, Perthshire, was used to protect cattle from all kinds of unspecified diseases. In addition to using the stone the animal had to be given, as a drench, water from a stream over which crossed the living and dead ("dead-water"). Into this water was placed two or three pieces of silver money "in the name of the Father, of the Son and of the Holy Ghost."[11]

Particular importance was attributed to "dead-water" and the belief in its medicinal powers persisted late into the nineteenth century. Its use, however, was regulated by several conditions. In the first place it must be collected as we have

seen from a stream over which the dead are carried and the living pass — a condition satisfied by a stream running in front of the entrance to a churchyard. In the second place the water must be brought in silence, that is, the bearer must not speak or be spoken to.* Lastly certain precautions had to be taken in disposing of any surplus water ; usually it was returned to the stream from which it was taken. Variants, of course, do occur in different localities. For example, a Kintyre farmer cured a cow suffering from the ill effects of the evil eye, by collecting water from a march (boundary) burn and bailing it out in three parts. The first in the name of the Father, the second in the name of the Son and the third in the name of the Holy Ghost. Salt in three parts was then added to the water in the name of the Trinity, and the solution was poured into the cow's ears and over her back. Another variant introduces a prayer before the application of the water in which the names of Paul, Peter and Mary occur.[12] And the *Clach-na-Brataich* amulet as we have seen had to be dipped in " fairy-water."

The potency of the " dead-water " charm cure could be enhanced by incorporating one or more added elements as in Dalchosnia, Perthshire, in 1826, where four water rolled pebbles and five old coins were dipped in water taken from a stream " from the march between two lairds, where the living and dead passed, in a three girded luggie. Alternatively the stones and coins were stirred round by hand three times. The water was then given to the cattle to drink.[13]

Naturally holed flints, pebbles and limstones, worn grooved and odd shaped stones represent, because of their greater or more common availability, the group exhibiting the widest variation and distribution. A large flint amulet found in the stables of a farm at Ashwell, England, was used in 1850 to protect the horses from a disease known as " Glander " (a glandular swelling of the neck).[14] In the north of Scotland a piece of coarse black basalt called the *Clach Spotaiche* or " Spotted Stone," was used " over the whole district for rubbing horses suffering from stoppage of the urine." And a curing stone called the *Claich Ruaidhe* or Red Stone was in common use at Ledaig near Loch Etive at the end of the nineteenth century " for rubbing the udders of cows when hardened and inflamed by disease."[15] On the Isle of Skye, " stones of a finger length and pyramid shape " found among the sands round Loch Siant were boiled in water and the infusion given to horses as a cure of intestinal worms.[16]

According to Train, writing from Scotland, bored or perforated stones were employed in Galloway to counteract the supposed influence of witchcraft and the evil eye on horses. He quotes " the canie wife o' Glengappock " who put a ' boirt (bored) stane ' into an tub filled with water and dipping a besom into the water she sprinkled each beast."[17]

At Ballyvourney, Cork, a spherical stone about six inches in diameter " of hard brown stone, like basalt " was used for the cure of murrain, and another about two inches in diameter of perforated banded agate known as the *Imokilly Amulet*, was in general demand for murrain and hydrophobia.[18] For the cure of the former it was dipped in the animals' drinking water.

A naturally perforated flint (Fig. 3.1.) from a farm at Ballyrasham, Ireland, was in use as late as 1900 as a protective amulet for safeguarding milking cows.

* This is a restriction which appears in the Old Testament. 2 *Kings* IV. 29.

To do this it was necessary to squirt through the hole the first strains of milk from a newly calved cow.[19] A perforated greenstone pebble was used in Cumbermauld, Scotland, to protect cattle from disease,[20] and similarly a green sandstone pebble with two holes was hung up in a byre in Dumfries.[21] Dark red heart-shaped pebbles, and pebbles of mottled serpentine were used in the Shetlands to cure ailing cattle and recover milk to cows.[22] In Ballymena, Ireland, a perforated pebble (Fig. 3.2.) was used for the same purpose.[23] The naturally holed limestone (Fig. 3.3.) known as a "witch-stone" from Yorkshire[24] and the dark naturally holed ironstone from Cambridge[25] (Fig. 3.4) were for similar reasons hung in the stable or cow-byre.

An ailment to which horses were subject was known in the north of Scotland as *Na Marcaich*, "the riders." The symptoms were abnormal sweating and tiredness, conditions which, lacking any rational diagnosis, were thought to be caused by the beasts being ridden by an invisible being called *Mara*. There appears to have been no cure, but protection against the ailment could be secured by the use of enchanted stones suspended in the stable or over the lintel of the stable door. These were usually naturally perforated pebbles or flints known as "hag-stones" in England and as "Mare-stones" in Scotland — see Fig. 4.

Butler refers to these perforated stones in *Hudibras* in speaking of Lilly, the astrologer, who could: —

> Chase evil spirits away by dint
> Of sickle, horse-show, hollow flint.

Pennant mentions a farmer in Pentolins, Dumfries, who considered "that a pebble naturally perforated was an infallible cure, hung over a horse that was troubled with nocturnal sweats."[26] The same custom was followed in Nithsdale in 1766,[27] and Aubrey in 1686 records that "in the West of England (and I believe almost everywhere in this nation) the carters, and groomes, and hostlers doe hang a flint (that has a hole in it) over horses that are hagge-ridden for a preservate against it."[28]

Manufactured Amulets

It was a commonly accepted belief that silver in one form or another was a potent countercharm to witchcraft and the evil eye. In the examples cited where coins were used, although the type of coin was not specified, it is reasonable to assume that they were of silver. Silver was used at Beauly, Inverness, so late as 1850, where "dead-water" was collected in a bucket made entirely of wood. A silver coin was placed in the bucket and the water was then ladled out in a wooden ladle and sprinkled over the sick cows.[29] A silver sixpence of George III — see Fig. 1.2. — called a "crossie-croon" shilling, was used as an amulet by a farmer's wife in the parish of Pitsligo. It was placed at the bottom of the milk cog when a cow was milked for the first time after calving as a safeguard against loss of milk.[30]

At Lockerby in Dumfriesshire is still preserved a piece of silver called the Lockerby Penny, which was used as a cure for madness in cattle. It was put in a cleft stick and used to stir the water in a well. The water was then bottled and given to any animal affected. It is reported that about 1875 on a Northumbrian

farm, a dog bit an ass, and the ass bit a cow ; the penny was sent for and a deposit of £50 actually left till it was returned. The dog was shot, the ass died, but the cow was saved through the miraculous virtue of the charm. On the death of a farmer who had borrowed the penny, several bottles of water were found among his effects, stored in a cupboard, and labelled " Lockerby Water."

Another Border charm, the Black Penny, was used in the cure of cattle madness. The penny, a Roman coin, was dipped in a well, the water of which ran towards the south (this was indispensable) ; sufficient water was drawn and given as a drench to the afflicted beasts.[31] A charm cure used by John Brughe, in 1643, consisted in taking " thrice turnouris " (three shillings) dropping them in a tub of clean water and without letting any of the water touch the ground, and given as a drench or, in Brughe's own words " of this, a cow being braine wod (mad) for the tyme, should drink."[32]

It is interesting to note that this particular " cow-doctor " had many prescriptions and his fee was proportioned according to the importance of the case. For curing oxen, for instance, by a pint of " new lettingoe wirt " accompanied with the invocation " God put thame in their awin place," repeated thrice, he got " eleevin od schillingis, with two peckis of meill and thrie tailyeis of beiff," and nine shillings for recovering a mad cow.

A variant prescription using " dead-water " and silver for horses and cattle, afflicted by the *beum sul* or the malign influence of the evil eye, is found in the Breadalbane district of Scotland. Water was taken " in God's name " from a stream across which the living passed and the dead were carried. It was put in a pail along with a silver coin ; some of the water was sprinkled into the ears and on the back of the afflicted animal. Finally the rest of the water was given to the animal to drink, and if the coin adhered to the bottom of the pail, the cure would be complete. Water from a loch it appears could be equally efficacious, and there is on record one instance at least, in which water from Loch Tay was used in this particular charm.[33]

The symptoms in cattle of being thus afflicted or " overlooked " were loss of milk, a tendency to kick, and, as the malady progressed, a " frantic wildness " which usually ended in collapse. Horses affected would sweat and tremble and grow weaker daily.

The Lee Stone, or Lee Penny, was probably the best known lithic amulet used in the cure of infected cattle. The amulet consists of a heart-shaped deep red pebble of carnelian-agate set in an Edward III silver groat. In an *Account of the Penny in the Lee*, written in 1702, it is stated that the amulet " being taken and put in the end of a cloven stick, and washen in a tub full of water ,and given to cattell to drink, infallably cures almost all manner of diseases."

Its power over cattle disease was so universally believed in and resorted to as an ordinary practice by " husbandmen of the best sort," that it became exempted from the anathema with which the Scottish clergy were denouncing other superstitious practices. As late as 1845, in Carluke, there could still be seen hanging in some byres a phial of Lea-Penny water, to keep cows from parting calf and to preserve the milk from changing.[34]

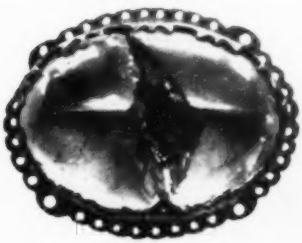

FIG. 1.1
The MacLean Loug, a rock crystal amulet mounted for suspension, from Ross of Mull, Scotland.

FIG. 1.2
George III Silver Sixpence or "crossie-croon" shilling from Pitsligo, Scotland.

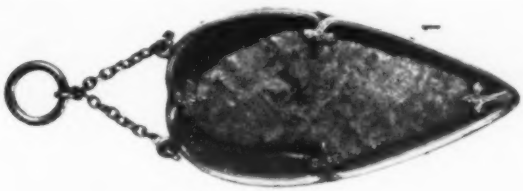

FIG. 1.3
Elf-arrow amulet in silver mounting for suspension, from Perth, Scotland.

FIG. 2
Ballochyle brooch amulet from Argyll, Scotland.

(Article by Davidson, page 205)

PLATE II

FIG. 3.1
Naturally perforated flint amulet from Ballyrasham, Ireland.

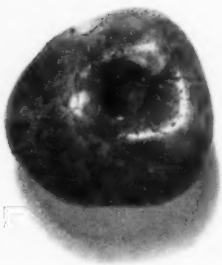

FIG. 3.2
Holed stone amulet from Ballymena, Ireland.

FIG. 3.3
Naturally perforated limestone amulet, from Fountains, England.

FIG. 3.4
Holed ironstone amulet from Cambridge, England.

(Article by Davidson, page 205)

PLATE III

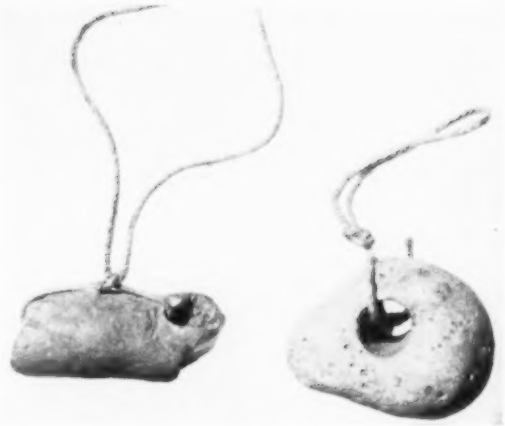

FIG. 4
"Mare-stone" amulets from Cambridge, England.

FIG. 5a
Rowantree amulets from Scotland.

FIG. 5b
Rowantree amulets from England.

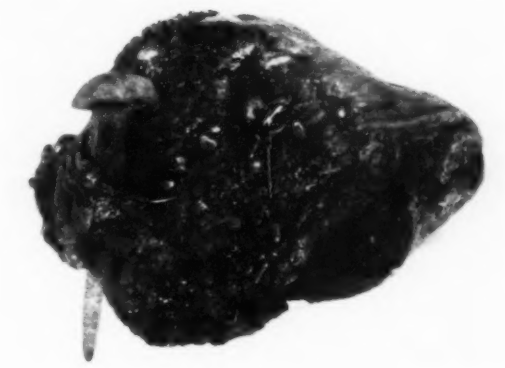

FIG. 6
Bullock's heart pierced with nails, from Somerset, England.

(Article by Davidson, page 205)

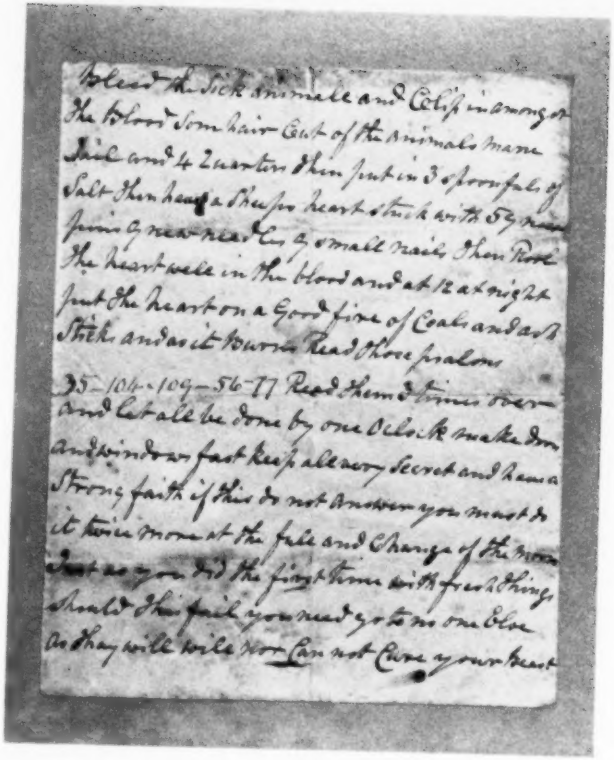

FIG. 7

Inscribed amulet from Yorkshire, England

FIG. 8

Corn amulets:
(a) "Kirnmaiden" from Forfar, Scotland (Top left).
(b) "Gwrach" from Pembroke, Wales (Top right).
(c) "Church" from Ireland (Bottom).

(Specimens—Fig. 1.1, 1.2, 1.3, Fig. 2 in National Museum of Antiquities of Scotland, Edinburgh; Fig. 3.1, 3.2, Figs. 5, 6, 7, 8 (b), (c) in Pitt Rivers Museum, Oxford; Fig. 3.4, Fig. 4 in University Museum of Archaeology and Ethnology, Cambridge; Fig. 3.3 Mrs. Hawthornthwaite, Fountains.)

(Article by Davidson, page 205)

Prehistoric artifacts, such as bronze axes, spear-heads, neolithic flints and ornaments were all used for the cure of and protection against diseases and distempers. The virtues ascribed to these objects derived from mistaken ideas regarding their origin and use. The marked uniformity in shape and size, their comparative rarity and the fact that they were always found in the ground, led people to believe that they were of supernatural origin, and consequently endowed with supernatural powers.

Ornamented early Iron Age beads of vitreous paste, some with enamelled spirals, found throughout Britain and commonly known as "adder-beads," were considered efficacious in the cure of numerous diseases, but particularly snake bite. As a cure, the beads were either dipped in water, boiled in water or on occasion the parts of the animal affected were rubbed with the bead.

One particular example, a bead of dark blue vitreous paste ornamented with inlaid spirals of yellow enamel found in a cist at Eddertown, Ross-shire, was used for many generations by one family in Skye. Farmers came from great distances to borrow the bead for treatment of diseased cattle.[35]

A flint arrow-head found in Port Glenone, Ireland, and a neolithic celt from Ballymena, Ireland, were both used as recently as 1897 and 1899. They were boiled in drinking water and the water given to cattle suffering from the "grup."[36] A bronze axe of the type with decorated flanges and slight stop ridges was employed by a farmer in Perth as late as 1877. It was kept in the cow-byre and was believed to possess the power to make cows yield well.[37] A neolithic axe was used by a "cow-doctor" of Armoy, Co. Antrim, in 1893. The implement was boiled in water which was then given as a drench to a "coo wi' the rotten grup."[38] Sir John Evans mentions an instance which came under his own observation in Ireland, "where a stone celt was lent among neighbours to place in troughs from which cattle drank, on account of its healing powers."[39]

Probably the most common and widely used amulets were the neolithic flint arrow heads or elf-arrows as they were called, which were found in abundance in all parts of the country. The origin of these arrows was shrouded in complete mystery and as a consequence considerable supernatural powers and virtues were ascribed to them. For example, in Ireland, where sudden sickness in cows was attributed to the fairies, the cure was to lead the animal three times round an ancient monument near a holy well, casting an elf-arrow on the monument. If this was not successful, then elf-arrows were tied up in cloth with a piece of money, and thrown into the animal's drinking water.[40] More commonly, however, the arrow was mounted for suspension (Fig. 1.3.) and dipped into water which was then given to the sick beast, as a drink or wash. On other occasions the animal was rubbed down with the elf-stone.

Simple protective amulets were manufactured from twigs of rowan tree. These were made into the form of a magic circle, that is, hoops or loops (Fig. 5) of varying sizes. Farmers generally throughout the British Isles suspended small loops in the stables and cow-byres, tied them on the cow's tail, milked the first streams of milk from a newly calved cow, through the loop and forced the cattle and horses to pass through large loops. In this way, it was thought, the health of the beasts would be preserved for the ensuing year.

The potency of the amulet could further be enhanced by binding the twigs into the sacred form of the cross with red thread wool or yarn (Fig. 5) for typical England and Scottish examples. In the north-east of Scotland rowan-tree crosses tied with scarlet thread were placed over the stable and byre doors and very often as an added precaution, red yarn was bound into the tail of each animal. On the Island of Lewis the burrach or cow fetter made from rowan tree was tied on the animal's hind leg when she calved.[41] During the cattle plague of 1866 there was, it is reported, " not a single cowshed in Marshland but had its wicken (rowan) cross over the door."[42]

As a means of protecting farm animals from the blight caused by the evil eye, a piece of red thread, knotted seven times was bound round a piece of rowan tree. The knots were cast on a thread about half a finger length apart, and the ends tied together by a " weaver's knot." The whole was then placed without anyone seeing it done over the stable or animal's stall.[43]

Wool, thread and yarn possessed more or less the same magical virtues. In Argyllshire during Hallowe'en different colours of worsted thread were tied on cattle as a prophylactic.[44] Red woollen thread was one of the active elements in a charm cure used by a Kirkmaiden wise woman for curing the " elf-shot " in cattle. A red woollen thread was tied to a flat whorl or hard sandstone and then dipped three times in water taken from a well on which the sun did not shine, by a young girl with red or yellow hair. A rhyme in Gaelic was said over the water which was then given to the cow to drink.[45]

" Elf-shot," a fairly common disease in horses and cattle, was the disease inflicted on an animal which had been shot at or struck down by an " elf-arrow," propelled by a witch or fairy. In Scotland the symptoms were " refusal to eat, looking languid and breathing hard," [46] in England, " the disease (elf) in horned cattle causes an over distention of the first stomach from the swelling of grass and clover when eaten with the morning dew upon it,"[47] and in Ireland, " the animal's hair stands upon her back, her ears lifeless and hanging."[48]

Reference to the elf shooting of horses can be carried very far back. In an Anglo-Saxon MS. of leechdoms, remedies and recipes or *Lacnunga* we are given several cures for " elf-shot." One example, in the form of a charm prayer, probably the christianised version of an earlier pagan charm, will suffice :

> " If the horse be elf shot : may the beasts on the earth be healed, they are shaken indeed in health. In the name of God the Father and of the Son and of the Holy Ghost may the devil be cast forth by the laying on of our hands. Who shall separate us from the love of Christ by the invocation of all thy saints, by Him, who liveth and reigneth ever without end. Amen. Lord wherefore are they increased thrice ; Rejoice, loose their chains, O Lord, thrice."[49]

It was, however, as " wrestling threads " *or snathainn* that threads acquired their greatest power. Its composition varied, for example, in Uist it was simply a red woollen thread four or five inches long dyed in alum : but generally it was a

thread of any colour on which were cast nine knots. Casting knots in this way was considered a sure method of curing diseases.

In the Orkneys the wresting thread was applied "in the name of the Father, Sone and the Holie Gaist," and for a sprain the thread was tied round the affected limb, at the same time chanting:

The Lord rade and the foal slade
He lighted and he righted
Set joint to joint
Bone to bone
And sinew to sinew
Heal in the Holy Ghost's name.[80]

This particular charm cure was also used in the Shetland Islands, but variants are to be found in Germany and Norway.

In the western highlands of Scotland when the thread was put about sick or diseased cattle, first the Pater was recited then the following:

An Eye will see you
A Tongue will speak of you
A Heart will think of you
He of the Arm is blessing you
The Father, the Sone and the Holy Ghost.
Four persons there are who may have done you harm
A man, a wife, a lad, a girl
Who is to turn that back
The Three Persons of the Most Holy Trinity
The Father, the Sone and the Holy Ghost
I call Mary to witness and Brigid
If it be a human thing that has done you harm
With wicked wish
Or with wicked eye
Or with wicked heart
That you (name of animal) be well
From the time I place this about you
In the name of the Father, the Sone and the Holy Ghost.[81]

For the cure of most diseases in animals the charmer in Inverness up to the present day uses what is known as a "spraining string." It consists of six equal strands of wool knotted at each end and in the middle. Their length varies according to the animal and that part of the animal round which the string is to be wrapped. While preparing the wool the charmer mutters the words, "Jesus went on horseback; and He sprained His foot. He said: Bone to bone, Flesh to flesh, Sinew to sinew, Blood to blood. And His flesh was made whole." The wool must not be permitted to touch the ground and it must be made in silence. It is then tied round the afflicted part of the animal and saying, "I tie this to you (animal's name) in the name of the Father, Son and Holy Ghost. By faith may you be made whole."[82]

Substantially the same rite was used by animal doctors in Ireland to find out whether a diseased horse or other animal would recover. The threads consisting usually of string or tape were made into the form of one or more loops called Worm-knots or *Snaaidm na peiste*, that is, loose knots of a special type. They were placed in front of and parallel to the animal. The ends were pulled and if the knot came undone, which it ought to do theoretically, the beast would recover — but if the knot jammed, the beast would die.[53]

Transfer Charm Cures. The largest group of superstitious practices are those connected with the ancient belief that disease could be transferred from one animal to another and from an animal to some inanimate object.

In the north of Scotland, extending over a wide area from Caithness to Aberdeen, when any loss occurred among cattle in the spring, the hooves and sometimes the head or parts of a beast were taken away to a wood and buried secretly, preferably on an adjoining estate and across a river.

"Wodness" or madness was a common distemper among cattle believed due to witchcraft. Known as "the heastie" because "it putteth them in a rage, and killeth them suddenly," it was cured by transporting a portion of the diseased animal from the owner's ground to the ground of another, the cattle of the latter sickened, while those of the former recovered.[54] In Mull the black spauld, the symptoms of which were a mortification in the legs and a corruption of the blood, raged like a pestilence among black cattle. One of the remedies was to bury alive the first cow to be afflicted and make the other cattle pass backwards and forwards over the pit.[55] In a similar way, at Fossoway, many cattle having died, the surviving animals were driven past a tub of water containing two enchanted stones and sprinkled with the water. One of the animals, unable to walk, was thrown "quick" (alive) in a hole over which the rest of the cattle were made to walk.[56]

Further south in the Lowlands a "cow-doctor" prescribed as a cure for the routing evill "a strange and suddane diseas quhairthrow an ox was never able to ly down, bot routted continuallie till he deid," "one quick ox with one catt, and one grit quantitie of salt and procedded to burie the ox and catt quick with salt in one deip hoill in the ground, that the rest of the guidis might be fred of the seikness or diseases."

An interesting rider to this case is that this procedure having been tried out, unsuccessfully, three times, application was then made to the Laird of Lee for the loan of the Lee penny. The application was rejected, "but flagons of the water wherein it was steiped, which giving the bestiall to drink, in their apprehension it cured them."[57]

Heart amulets (Fig. 6) are interesting because they not only act as transference charms but possess the enhanced virtue of punishing the witch responsible for the disease. A calf's heart was found under the floor of what had once been a cow byre in Dalkeith in 1812. According to the record, a disease thought to be due to the effects of witchcraft broke out and spread among the cattle. In order to stay the disease the heart of one of the diseased animals was taken out, roasted on a spit and with each turn of the spit a pin was stuck into the heart until it was completely roasted. The heart was then secretly deposited near the cattle.[58] The

bullock's heart, shown in Fig. 6, pierced with large nails and thorns was found in 1893 suspended in a chimney at Shute's Hill Farm, Chiptable, Somerset.[59]

A pig's heart pierced with pins and white thorns was found in 1882 hanging up in a chimney recess in an old house in the village of Ashbrittle, Somerset. The heart when found was in a flannel bag, black, rotten and crumbling to pieces. Another pig's heart was found nailed up inside the "clavel" in the chimney of an old house at Staplegrove in 1890. One side of the heart was stuck thickly with pins, the other side had only the letters M D traced out in pins. M D presumably were the initials of the witch.[60] The heart motive appears in an inscribed charm from Yorkshire, (Fig. 7) which prescribes as a cure for diseased cattle, the piercing of an ox heart with nine new pins, nine new needles and nine small nails. The heart had to be burned at midnight while two cursing psalm verses were said. Here again the intention was to torture the person who had charmed or bewitched the cattle.

We note that in most of the examples cited, the disease was got rid of by burying a part of or the whole diseased animal, so that as the animal rotted away in the earth the disease would in a similar way slowly die out of the rest of the herd. There are a great number of variations on this simple idea of transfer. Instead of burying one of the diseased animals, one of the prime and healthy beasts was killed and buried, for example, Sir James Simpson, the discoverer of chloroform, who records on a farm near Edinburgh at the end of the nineteenth century, his father offered up and buried a live cow "as a sacrifice to the spirit of Murrain."[61] During the Marshland, Lincolnshire, cattle plague of 1866, a calf was killed and solemnly buried feet pointing upwards at the threshold of the cow shed. The charm failed to arrest the plague, because, we are told the farmer sacrificed instead of his best calf, one of little value.[62]

Another method of disposing of the animal is found in Wales where in 1812, a particularly violent disease broke out among the horned cattle. The farmers in the districts affected united to give up a bullock for a victim which they carried to the top of a precipice and cast down. This was known as "casting a capture to the Devil." In Cornwall, about 1860, a calf was burnt to death to arrest the murrain and at Inverasdale, Moray, in 1861, a cow was buried alive for the same reason.[63]

Remnants of the belief lingered up to the late nineteenth century in many variant forms, for example, on Greelands farm on Barnby Moor, horses and foals were dying or falling sick. The farmer was directed by the wiseman of Barnby to dig a pit in the gateway of the stockyard, and in it bury the last victim, in this case a young foal. He was further directed to nail horse-shoes over the stable doors.[64] In some parts of Cleveland it was customary when a mare foaled to hang up the cleansings (the placenta) in a tree, usually a crab or thorn. The motive here was to ensure freedom from disease throughout the life of the foal. If the birth took place in the field a tree was chosen at random, if at the homestead a tree specially reserved for the purpose was used. A lamb that was dropped dead was also hung up in the same tree.[65] The Rev. Baring-Gould remarking on this custom says, "I have often observed in the Weald of Sussex dead horses and calves hung up by the four legs to a horizontal branch of a tree. A magnificent elm at West-

meston, just under Ditchling Beacon was constantly loaded with dead animals: one spring I saw two horses and three calves."[66]

The same principle motivated the rite used in Lincolnshire and Yorkshire when a horse had any ailment in the feet or legs. The first sod on which the animal put his foot in the morning was dug up and turned over. This was believed to be an infallible cure.

In the parish of Lochcarron, the *abaidail*, a sort of colic to which cows on hill pasture are subject was cured very simply as follows: the first person to see the suffering animal twists a rope against the sun, that is, anticlockwise, passes it round the cow's body, cuts it into three parts and burns it.[67]

In England, paralysis of a limb was put down to the crawling of a shrew mouse over it, and a cure was effected by allowing one of these creatures to die in an auger hole in the trunk of a tree, and then drawing a twig from the same tree across the afflicted limb. Similarly, in Scotland and Ireland, a disease, called the *connoch* was prevalent among cattle. To avert danger threatening cattle feeding where the connoch worm had crawled, they were sprinkled with, or made to drink of an infusion of the leaves and branches of a tree where one of these worms, plugged in an auger hole, like the shrew mouse, had been left to perish. Murrain in the Kilkenny district of Ireland at one time attributed to a sting on the mouth from the larvae of a particular species of moth was cured in the same way. A hole was bored in an ash tree and then plugged up with one of these live caterpillars and the leaves of the tree given as a specific against the disease.[68]

Finally, we come to a group of transfer charms consisting of corn amulets which were used solely as a means of protection against disease. Growing crops, it was believed, were animated by a corn or fertility spirit which was thought to retreat in front of the reapers until eventually it was forced to take refuge in the last sheaf left standing on the field.

The belief that this last sheaf possessed both a protective and fertilising influence over animals, although generally recognised throughout most counties of the British Isles, seems restricted in its actual application to the cure of animals, to Scotland.

The stacks of corn in the sheaf were made into figures called by such regional names as corn-maiden and clyack in Scotland, in England, as kern-dolly and neck, in Wales, as gwrach, and in Ireland as churn and hare, (Fig. 8). They were kept at the farm until the late autumn or winter when they were distributed among the animals.

In the north east of Scotland, the amulets were given to the cattle, to the plough horses and the first mare to foal, to safeguard them from ill-health and "make them thrive all the year round." On the west coast the amulets were preserved until the spring "for the purpose of preventing the death of the horses during the ensuing year." In Skye, when the first snow fell, the amulet was given to the cows as a countercharm against the evil eye.[69]

As in the case of "dead-water," these corn amulets could not lightly be thrown aside if they were not used for the purpose for which they were intended. They had to be buried or burnt.

The idea underlying the use of these amulets and charms rests upon the belief in the principles of sympathetic magic in its most elementary forms, similarity, imitation and transfer., These principles are the natural consequences of the laws of the association of ideas that to operate on a likeness or representation of an object affects that object ; and a part of any object may be substituted for the whole.

Briefly " like affects like," similarity is mistaken for identity and the part suggests the whole, hence it followed that a disease, for example, could be transferred to or from an animal or to an inanimate object by simply bringing the two into contact. The diseased animal or part of it was buried, burnt or hung up in a tree, and as it rotted or burned so would the disease die away from the rest of the beasts.

Similarly a wresting thread was tied round a broken limb, removed and knotted, the knot simulating the bonding together of the broken bone, then burnt or buried. Water in which amulets were dipped would, when sprinkled over the animal, take up the disease and carry it safely to the ground. The supernatural curative virtues of the amulet could also be conveyed to the animal directly by touch, i.e. tying on the tail, horns or rubbing on the afflicted part, or indirectly by giving it water in which the amulet had been dipped as a drench.

The persistence, up to the end of the nineteenth century, of beliefs resting on the assumption, tacit in primitive practices but explicit in mediaeval medicine, that " like affects like," in the face of the hostility and censure of the church, and the progress in veterinary science, can only be due to their simplicity, the unwillingness to give up what has been traditionally sanctioned and, possibly, the fact that they sometimes effected what they were designed to effect.

The examples of amulet and transfer cures discussed show clearly by their variety and wide distribution the important part they played in the supposed cure of and protection against sickness and epidemic outbreaks. In spite of the supernatural and often fantastic features of most of them, there are some which contain a substantial element of rationalism, indeed a high degree of primitive reasoning based on long and acute observation. Milkmaids, it was noticed, who lived in the " long house " close to the cows suffered from cow pox, but those who caught cow pox escaped small pox. This, as we know, led to early inoculation and eventually to vaccine treatment, and precisely the same reasoning can be seen behind the shrew-mouse, caterpillar and *connoch* worm examples of simple transfer cures.

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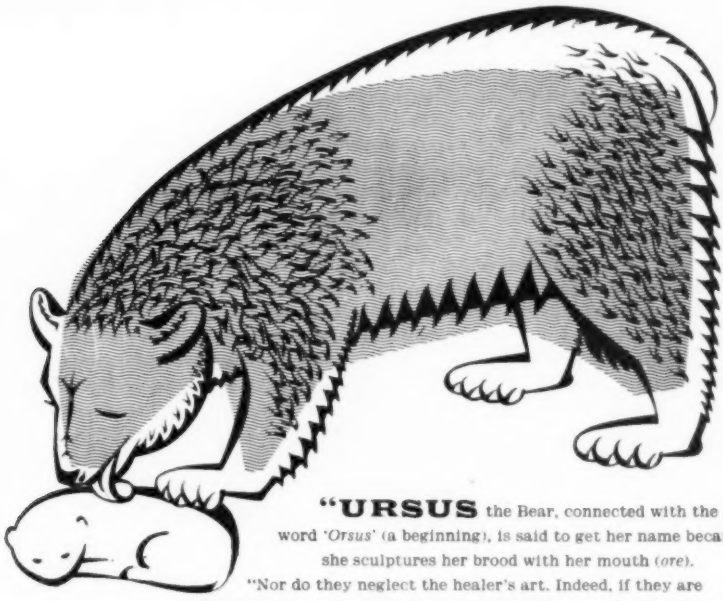

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THE EFFECT OF VARIOUS SEX HORMONES ON INFERTILE BUFFALO-COWS

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Hormone inbalance is a most important cause of infertility among domestic animals. (Brook and Rowson, 1952 ; Hamond, 1953 ; and Asdell, 1953). It is the aim of this work to investigate the extent to which sex hormones could be applied for correcting some reproductive disturbances in the buffalo-cow.

Experimental

Three hundred and seventy-seven buffalo-cows of known history with symptoms of infertility were injected with sex hormones and related substances. Stilboestrol dipropionate and pro-gesterone, oily solutions (B.W.), F.S.H. in the form of pregnant mare serum " Lutoantine, Richter," L.H. in the form of an oily solution of chorionic gonadotrophin " Prolan, Bayer," and posterior pituitary hormone " Hypophysin, Bayer " were used in this work. All hormonal solutions were given intramuscularly in the region of the gluteal muscles and varying doses were employed according to the sexual cause of infertility. The genital organs were examined by rectal palpation and animals with incurable abnormalities were discarded. The condition of the genital organs, hormonal treatment, interval between drug administration and the appearance of heat signs and the number of inseminations were recorded. The animals were examined after treatment and those showing signs of heat were inseminated artificially with one ml. of semen twice at 12 hours interval. Diagnosis for pregnancy was made by rectal examination 70 days after the last insemination. The effect of the various sex hormones on the conception rate was calculated as follows:—

Number of pregnant animals X 100 = conception rate.

Total number of inseminations.

The letters A, B, and C used in the tables indicate: ovaries containing corpora lutea, ovaries with developing Graafian follicles and " subfunctioning " ovaries respectively.

Results

1 — The Effect on Anoestrous Buffalo-Cows

Animals were divided into groups according to their sexual disorders and treated with the suggested hormones. The results were then recorded as follows:—

(a) *Stilboestrol dipropionate*

Stilboestrol dipropionate was administered to 97 anoestrous buffalo-cows ; the reliability of the drug is summarised below :—

TABLE 1

The Conception Rate of Buffalo-Cows
treated with Various Doses of Stilboestrol Dipropionate

Dose of Stilboestrol (mg.)	25			20			15			10			5		
Ovarian Condition	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Conception Rate %	57.1	57.1	66.0	58.8	50.0	80.0	58.8	85.7	57.1	57.1	50.0	33.3	0	33.3	0

(b) *Luteinizing Hormone:*

Gonadotrophic luteinizing hormone was administered to 47 anoestrous buffalo-cows and the results are shown below:—

TABLE 2

The Conception Rate of Buffalo-Cows
treated with Various Doses of Luteinizing Hormone

L.H. Dose (i.u.)	1,000			800			600			400		
Ovarian Condition	A	B	C	A	B	C	A	B	C	A	B	C
Conception Rate %	50.0	66.6	66.6	70.0	66.6	50.0	55.5	25.0	33.3	0	0	0

(c) *Stilboestrol Dipropionate and Luteinizing Hormone*

Combinations of different doses of stilboestrol dipropionate and of ascending doses of luteinizing hormone were injected to 170 anoestrous buffalo-cows and the results are summarised below:—

TABLE 3

The Conception Rate of Buffalo-Cows
treated with Stilboestrol Dipropionate and Luteinizing Hormone

Dose of Stilboestrol (mg.)	Dose of Luteinizing Hormone (i.u.)														
	200			400			600			800			1,000		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
25	66.6	33.3	50.0	50.0	50.0	50.0	50.0	50.0	50.0	33.3	66.6	66.6	33.3	66.6	66.6
20	75.0	33.3	50.0	75.0	40.0	50.0	50.0	50.0	50.0	50.0	66.6	66.6	42.8	66.6	66.6
15	75.0	20.0	66.6	75.0	50.0	66.6	75.0	66.6	66.6	66.6	75.0	66.6	50.0	75.0	50.0
10	66.6	20.0	28.5	66.6	33.3	50.0	50.0	40.0	80.0	50.0	40.0	50.0	50.0	66.6	40.0
5	0	0	0	50.0	20.0	20.0	50.0	40.0	50.0	50.0	40.0	50.0	75.0	50.0	66.6

Conception rates are given in percentages

(d) *Follicular Stimulating Hormone:*

Gonadotrophic follicular stimulating hormone was administered to 35 buffalo-cows and the result is shown as follows:—

TABLE 4

The Conception Rate of Buffalo-Cows treated with Gonadotrophic Follicular Stimulating Hormone

F.S.H. Dose (R.U.)	1,200			1,000			800			600			400		
Ovarian Condition	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Conception Rate %	50.0	66.6	60.0	50.0	66.0	60.0	33.3	50.0	50.0	0	0	0	0	0	0

2 — THE EFFECT ON CYSTIC OVARIES AND NYMPHOMANIA

(a) *Luteinizing Hormone*

Gonadotrophic luteinizing hormone was administered to four buffalo-cows suffering from cystic ovaries "cystic ovarian degeneration." One of them was exhibiting periods of intense heat at frequent intervals; the others were not showing any signs of heat. The results obtained from using this hormone in each of four cases are shown below:—

TABLE 5

The Effect of Luteinizing Hormone on Cystic Ovaries

No.	Total amount required for treatment (i.u.)	Period between treatment & normal oestrous cycle (days)	Number of inseminations	Condition after insemination
1	9,000	21	3	pregnant
2	9,000	21	1	pregnant
3	9,000	35	2	pregnant
4	6,000	20	8	pregnant

(b) *Progesterone:*

Progesterone was administered to four buffalo-cows suffering from cystic ovaries. The results are shown below:—

TABLE 6

The Effect of Progesterone on Cystic Ovaries

No.	Total amount required for treatment (mg.)	Period between treatment & normal oestrous cycle (days)	Number of inseminations	Condition after insemination
1	600	15	5	not pregnant
2	700	35	4	" "
3	900	42	5	" "
4	900	21	4	" "

3 — The Effect of the Expulsion of Retained Placenta

(a) *Stilboestrol dipropionate:*

Stilboestrol dipropionate was injected into six buffalo-cows with retained placenta. An intramuscular injection of 10 mg. of stilboestrol dipropionate was given every 24 hours till all foetal membranes were expelled. The results are shown in the following table:—

Table 7

The Effect of Stilboestrol Dipropionate on the Expulsion of Retained Placenta

No.	Total dose required for expulsion of placenta (mg.)	Time required for expulsion of placenta
1	10	Within 24 hours
2	20	Between 24 & 48 hours
3	20	Between 24 & 48 hours
4	10	Within 24 hours
5	10	Within 24 hours
6	20	Between 24 & 48 hours
7	10	Within 24 hours
8	40	Between 24 & 96 hours

(b) *Stilboestrol dipropionate and posterior pituitary extract:*

stilboestrol dipropionate was injected into six buffalo-cows with retained placenta. Intramuscular injections of 10 mg. of stilboestrol dipropionate was followed in 3 hours with 100 units of posterior pituitary extract; injections were repeated every 24 hours till the expulsion of the retained placenta. The following table gives the results:—

Table 8

The Effect of Stilboestrol Dipropionate (A) and Posterior Pituitary Extract (B) on the Expulsion of Retained Placenta

No.	Total dose required for expulsion of placenta	Time required for expulsion of placenta
1	10 mg. (A) + 100 I.U. (B)	Within 24 hours
2	10 mg. (A) + 100 I.U. (B)	Within 24 hours
3	20 mg. (A) + 200 I.U. (B)	Between 24 and 48 hours
4	10 mg. (A) + 100 I.U. (B)	Within 24 hours
5	10 mg. (A) + 100 I.U. (B)	Within 24 hours
6	10 mg. (A) + 100 I.U. (B)	Within 24 hours

4 — The Effect of Stilboestrol Dipropionate on Pyometra

The effect of stilboestrol dipropionate on pyometra was studied in 8 buffalo-cows. Pus was evacuated from the uterus by means of a double channel uterine catheter and the corpus luteum was squeezed: 10 mg. of stilboestrol dipropionate was given on four occasions at 7 days interval. Oestrous cycle was restored in all animals from 1 to 2 months later. The animals were inseminated and diagnosis for pregnancy revealed that one animal only conceived.

Discussion

Fertility in animals is influenced by the two main gonadotrophic hormones of the anterior pituitary gland: the follicular stimulating one which causes the follicles to ripen and the luteinizing hormone which causes ovulation and the development

of corpora lutea. The actual amounts of these substances in the blood stream are important as well as the relative proportions of oestrogen and progesterone. The fertility or sterility of farm animals may depend on these proportions and the efficacy of the balance. In this present work, sex hormones and similar substances were administered to buffalo-cows suffering from different reproductive disorders and encouraging results were obtained. The hormones were effective in stimulating anoestrous buffalo-cows suffering from various ovarian conditions. This may be due to changes in the hormone balance and the more rapidly the animal can regain this balance the better the result. The different results obtained from the hormonal treatment of functional infertility has been reported by many. Brock and Rowson (1952) stated that if the follicles of adult cows are ripened by injections of pregnant mare serum and this is followed by an interval of about 5 days, then injections of luteinizing hormone show that the ova are dead before they are shed from the follicles. Hammond (1953) added that the egg may under the influence of progesterone, pass too quickly down the tubes and either not become fertilized or perish in a uterus which is not yet ready to receive it. Asdell (1953) stated that impaired nutrition appears to reduce the secretion of follicle stimulating hormone by the anterior pituitary and in the young animal, full ovarian development is prevented. In the adult, it causes a failure in the development of Graafian follicles and ovarian atrophy is the consequence. Hammond (1953) also postulated that there is evidence for the conclusion that the plane of nutrition of the animal has a qualitative effect on the results obtained from a given dose of a hormone..

Garm (1950) pointed out that cystic ovarian degeneration may not be an independent disease, but may be one symptom of two different endocrine disturbances, viz., nymphomania and adrenal virilism. In this work the results show that luteinizing hormone is more efficient in the treatment of cystic ovaries than progesterone and this may be due to the consequent rupture of the cysts and the formation of lutein tissue ; progesterone antagonizes the high level of oestrogen in the blood and stimulates the secretion of the luteinizing hormone which helps in the rupture of the cysts.

Retained foetal membranes were expelled after stilboestrol was used either alone or with posterior pituitary extract. Stilboestrol sensitizes the uterus to the action of the hormone secreted by the posterior pituitary gland and when used in combination with it sensitizes the uterus to the posterior pituitary hormone injected as well as that secreted. This may explain why stilboestrol in combination with the posterior pituitary extract expelled the retained foetal membranes more quickly than when stilboestrol was used alone.

The incidence of pyometra in buffalo-cows is high. The antiseptic property of stilboestrol and its oestrogenic effect suggested its use in the treatment of pyometra. It is seen that 40 mg. is sufficient when given intramuscularly in 4 doses at intervals of one week. Although the normal oestrous cycle was restored in one to two months one only out of eight animals became pregnant. The milk yield of animals treated with 25 and 20 mg. of stilboestrol dipropionate was reduced by about 30 per cent.; other doses caused slight reduction. The milk yield was also reduced when luteinizing hormone doses ranging from 200 to 1,000 i.u. were combined with stilboestrol dipropionate in doses of 25 to 10 mg.

Summary

Sex hormones and similar compounds were injected intramuscularly into 377 buffalo-cows affected with different reproducive disorders. Combinations of 15 mg. of stilboestrol dipropionate and 200 i.u. luteinizing hormone or 5 mg. of the former and 1,000 i.u. of the latter stimulated anoestrous buffalo-cows so that their ovaries contained corpora lutea. A dose of 15 mg. of stilboestrol dipropionate alone restored the reproductive functions of anoestrous buffalo-cows with ovaries containing developing Graafian follicles more readily than when given in combination with 800 i.u. of luteinizing hormone or when 800 i.u. of luteinizing hormone or 1,000 R.U. of follicular stimulating hormone were given. Anoestrous buffalo-cows with subfunctioning ovaries responded more readily after treatment with 20 mg. of stilboestrol dipropionate alone or with 10 mg. combined with 600 i.u. luteinizing hormone than with 1,000 R.U. of follicular or stimulating hormone.

Gonadotrophic luteinizing hormone was used successfully, in doses ranging from 6,000 i.u. to 9,000 i.u., in nymphomania and cystic ovaries of buffalo-cows.

The amount of stilboestrol dipropionate needed for expulsion of foetal membranes in buffalo-cows ranged from 10 to 40 mg. when used alone and ranged from 10 to 20 mg. when used in combination with 100 or 200 i.u. of posterior pituitary extract. Stilboestrol dipropionate was also valuable in promoting the evacuation of pus from the uteri of buffalo-cows affected with pyometra and for restoring the normal oestrous cycle.

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THE INFLUENCE OF THE MAGNESIUM CONTENT OF THE BLOOD-SERUM ON THE ELECTRO-CARDIOGRAM IN MILK COWS

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Introduction

Peters and Van Slyke (1931) reported that not much was known about the clinical meaning of disturbances in magnesium metabolism. Little more is known now. We are slightly better informed than we were 30 years ago, because the determination of the magnesium content has become easier. We know that intracellular magnesium plays an important role in activating various enzyme systems. Furthermore, it has proved to be a suppressor of the central and peripheral nerve stimuli, and if concentrations are too low motor irritability is increased and this could cause spasms. Moreover, the nervous system of the heart would be suppressed and vasodilation occur, and this would result in lowering of the blood pressure.

Engbaek (1952) throws more light on these last symptoms, while Elkinton (1957) describes the significance of Mg for the animal organism, as far as it is known today, in a more general survey.

The significance of the Mg in respect to the functioning of the heart particularly attracted my attention and, thanks to the Institute for Biological and Chemical Research of Agricultural Crops at Wageningen, I had the opportunity to take electrocardiograms of a number of cows, whose magnesium content of the blood serum varied from 0.6 per cent. to 2.8 mg. per cent.

The 14 animals concerned were used by Kemp (1958) for a grazing experiment, described elsewhere, in which the influence of grassland fertilisation on the serum Mg content was studied.

The first electrocardiograms were taken towards the end of the grazing period (14th October, 1957); the second at the beginning of the housing period (19th November, 1957) and the third at the end of the housing period (29th April and 1st May, 1958).

In this way it was possible to ascertain if the differences between the electrocardiograms of cows with a low serum Mg content and those with a normal serum Mg content were really connected with the differences in Mg contents. For, if this were so, these differences should have disappeared at the second and third readings, unless it must be supposed that the hearts of animals which had lived with a too low serum Mg content during practically the whole grazing period, was damaged more or less permanently.

The electrocardiograms of cows with hypomagnesaemia were taken because it was known that the Mg content of the blood serum is of great importance for the function of the neuromuscular system in general (Engbaek, 1952) and for the function of the heart in particular (Zwillinger, 1935; Seekles, 1936; Engbaek,

1952). Moreover, it is known that grass tetany patients often die of heart failure.

Not much is known about the influence of magnesium on electrocardiograms, and certainly not about magnesium deficiency. Katz (1946) mentions the importance of Na, Ca and K concentrations and also alkalosis, acidosis, hypoglycaemia and the concentrations of some hormones, but does not mention Mg. Sykes and Alfredson (1940) describe the influence of K-shortage and Hamburger (1957) found a marked extension of the QT-interval of the electrocardiogram by increasing the Mg content (and decrease of the Ca content) in the blood serum of man. Zwillinger (1935) saw that by means of an $MgSO_4$ injection the PR-interval in his patients was extended.

The normal electrocardiogram of cattle is discussed by Alfredson and Sykes (1942) and Brooymans (1957).

Technique

The electrocardiograms were registered with a portable electrocardiograph, the Viso-Cardiette, Model 52 of the Sanborn Company (Cambridge, Massachusetts).

For the registrations on the 14th October, the cows were brought in from the fields and rested for at least a quarter of an hour. In the other registrations stabled animals were used.

The cows were placed on earthed chicken wire, which was covered with felt, before the electrodes were fixed to the legs. A thick rubber mat was placed beneath the felt-covered wire.

Before the plate electrodes were fixed round the legs with a perforated rubber band, the plates were covered with a thick layer of shaving cream and, to obtain the best possible contact with the skin, shaving cream was rubbed well into the skin and between the hairs. Three electrodes were fixed to each cow, namely to each foreleg and the left hind leg. As is usual we called the connection with both fore legs Lead I; the connection of right fore- and left hind leg Lead II and the connection of both left legs Lead III.

The sensitivity of the electrocardiograph was regulated so that a current of 1 mV would give a fluctuation of 10 mm., while the paper band moved at a speed of 25 mm. per second (1 mm. = 0.04 sec.).

With the aid of the electrocardiograms the following data were determined:

(a) pulse frequency and duration of the RR-interval;
(b) duration of the PR-interval;
(c) duration of the RT-interval;
(d) duration of the PT-interval.
(e) duration of the QRS-interval;
(f) Bazett's Constant (1920) $C=\frac{RT}{\sqrt{RR}}$
(g) the extent of the fluctuations in mV of the QRS—as well as of the P- and the T-top.

All these data were correlated as much as possible with the Mg content in the blood serum of the animals.

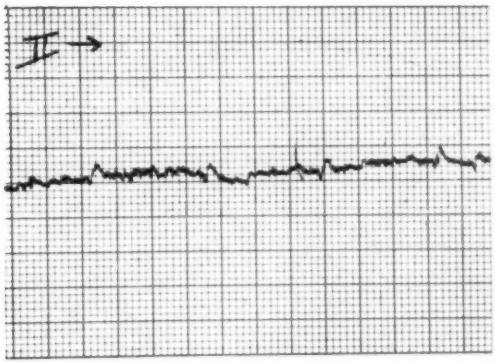

FIG. 1

E.C.G. of cow with Serum Mg content of 0.6 mg. per cent.; lead II taken 14th October, 1957.

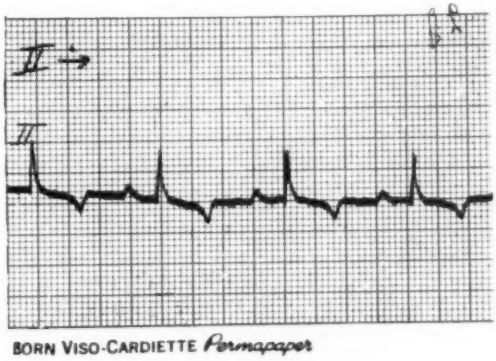

FIG. 2

E.C.G. of cow with Serum Mg content of 2.7 mg. per cent.; lead II.

(Article by de Groot, page 225)

PLATE VI

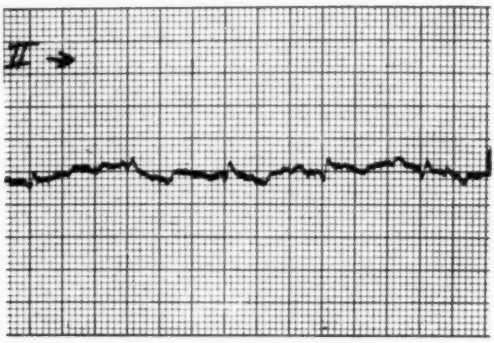

FIG. 3

E.C.G. of the same cow as in fig. 1; Serum Mg content 2.8 mg. per cent.; lead II taken 19th November, 1957.

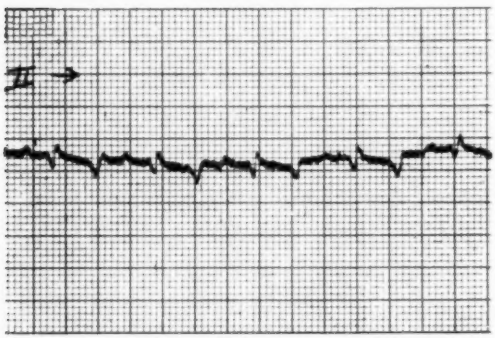

FIG. 4

E.C.G. of the same cow as in fig. 1 and 2; Serum Mg content 2.3 mg. per cent.; lead II taken 29th April, 1958.

(Article by de Groot, page 225)

The registrations of the electrocardiograms, as well as the particulars of the serum Mg contents, are shown in Table I. The different calculated correlation coefficients are shown in Table II.

TABLE I

Date	Pulse Rate					Distance P to R in 0·01 sec.				Distance R to T in 0·01 sec.				Distance P to T in 0·01 sec.		
	beats/min.		M	m	δ	max.	min.	M	m	δ	max.	min.	M	m	δ	max.	min.	M
	max.	min.																
14/10	85·3	56·4	67·14	2·26	8·46	21·1	14·8	18·8	0·55	2·06	32·0	25·0	29·3	0·54	2·02	54·7	40·9	48·3
19/11	100·8	67·6	79·43	2·37	8·86	21·1	14·8	18·0	0·66	2·47	33·6	24·4	30·1	0·74	2·78	54·7	40·9	48·2
29/4	92·2	67·1	77·57	2·01	7·50	—	—	—	—	—	32·6	26·9	30·6	0·44	1·65	54·8	43·2	49·2

Date	Distance P to T in 0·01 sec.		Distance R to R in 0·01 sec.					QRS lead I in 0·01 sec.		QRS lead II in 0·01 sec.		QRS lead III in 0·01 sec.		Serum Mg. content, mg. %				
	m	δ	max.	min.	M	m	δ	max.	min.	max.	min.	max.	min.	max.	min.	M	m	δ
14/10	0·91	3·41	106·5	70·4	90·7	2·80	10·40	8·2	3·1	8·3	5·0	10·0	2·7	2·8	0·6	1·81	0·17	0·65
19/11	1·13	4·23	88·8	59·5	76·8	2·44	9·14	—	—	—	—	—	—	3·5	2·0	2·82	0·10	0·38
29/4	0·93	3·49	—	—	—	—	—	—	—	—	—	—	—	2·7	2·2	2·50	0·05	0·19

M = average.
m = mean square error.
δ = standard deviation.

TABLE II

Date	'pulse Mg	'PR Mg	'RT Mg	'PT Mg	'pulse PT	$\frac{'RT}{\sqrt{RR}}$ Mg
14/10	−0·77 ±0·11	+0·49 ±0·20	+0·90 ±0·05	+0·79 ±0·10	−0·73 ±0·14	+0·55 ±0·19
19/11	−0·20 ±0·26	−0·05	+0·27 ±0·25	+0·15 ±0·26	−0·96 ±0·02	—
29/4	−0·51 ±0·20	—	+0·43 ±0·22	+0·51 ±0·20	−0·58 ±0·18	—

Date	'pulse Mg.PT	'PT Mg.pulse	'pulse PT.Mg	'pulse Mg.RT	'RT Mg.pulse	'pulse RT.Mg
14/10	−0·46	+0·52	−0·30	−0·25	+0·45	−0·32
19/11	−0·20	+0·15	−0·99	—	—	—
29/4	−0·31	+0·31	−0·38	—	—	—

The Experiment on 14th October, 1957

The correlations between serum Mg content and pulse rate and between serum Mg content and duration of RT- and PT-interval are highly significant. The correlation between serum Mg content and duration of the PR-interval is not quite significant, though not without importance.

The correlation coefficients between serum Mg content and the three distances of the E.C.G. are positive, which means that these shorten accordingly as the serum Mg content decreases. The correlation coefficient between the serum Mg content

and the pulse rate is negative, which means that the pulse rate increases accordingly as the serum Mg content decreases further ; Zwillinger (1935) found that an Mg injection lowers the pulse rate in man.

The duration of the QRS-interval did not show a marked connection with the serum Mg content, although Sykes and Alfredson (1940) found it so when changing the K-content of the blood serum. The QRS-interval was further left out of consideration.

There was, however, a marked difference in the duration of the QRS-interval in the three leads (I average 0.047 sec. ; II average 0.070 sec. ; and III average 0.080 sec.). Table I shows this variation.

It is known that a change in the pulse rate is coupled with changes in the length of the PT- and RT-interval, in as far as a quickening of the pulse accompanies shortening of these intervals ; the partial correlation coefficients were thus calculated and the results show that not one of the observations of the 14th October is significant. This may be partly due to the small number of animals available for the experiment. Nevertheless, these correlation coefficients give the impression that the connection between the Mg content of the serum and the duration of the PT- and RT-interval is greater than that between the pulse rate and these two distances.

Considering the small number of observations, far-reaching conclusions should not be drawn and for this reason it was attempted to determine approximately the influence of the Mg content of the serum on the duration of the RT-interval, eliminating the influence of the pulse rate, in a different way, namely with Bazett's Constant C. (1920). This author proved that the ratio $\frac{RT}{\sqrt{RR}}$ is constant in healthy individuals.

However, in the cows examined by us on 14th October, Bazett's C proved to vary from 0.29 to 0.33, and as a rule the lowest values were found in animals with the lowest Mg content of the serum. The average C value was 0.3093 ± 0.036 and the correlation coefficient between C and the serum Mg content was nearly significant ($r = +0.55 \pm 0.19$).

This is in favour of a connection between the serum Mg content and the duration of the RT-interval. Hamburger (1957) found that in man a high Mg (and low Ca) content of the serum was accompanied by an increase of Bazett's C which accords with our observations, namely that a decrease of the serum Mg content gives a lower C value.

The amplitudes of the various tops fluctuate between the limits given by Alfredson and Sykes (1942) for the three different leads (except that a certain top was not always visible, and these research workers gave 0.03 mV as the smallest fluctuation). The amplitudes of the Q-, R- and S-top are not determined separately, but the total amplitude-difference between QR was measured by this standard (Table III).

TABLE III

Amplitudes of the E.C.G.s on the 14th October

Top	*Lead*	*Minimum in mV*	*Maximum in mV*	*Average in mV*
P	I	0	0.11	0.060
	II	0.03	0.13	0.078
	III	0	0.07	0.024
QRS	I	0.15	0.67	0.365
	II	0.15	1.39	0.538
	III	0.22	1.26	0.503
T	I	0.17	0.46	0.265
	II	0.14	0.46	0.288
	III	0.05	0.22	0.147

Although (see Table IV) the amplitudes of nearly all tops of all three leads were on an average larger in the E.C.G.s of animals with a serum Mg content of 2 mg. per cent. or higher than in the E.C.G.s of animals with a content lower than 2 mg. per cent., there was no significant correlation between the serum Mg content and the extent of the fluctuation.

TABLE IV

Averages of the amplitudes in mV

Top	*Lead*	*E.C.G. of animals with serum-Mg. content <2 mg. %*	*E.C.G. of animals with serum-Mg. content >2 mg. %*
P	I	0.048	0.069
	II	0.061	0.090
	III	0.025	0.023
QRS	I	0.297	0.416
	II	0.385	0.634
	III	0.420	0.555
T	I	0.231	0.291
	II	0.271	0.301
	III	0.116	0.167

There is another difference between the E.C.G.s of animals with a low and animals with a high serum Mg content. Two E.C.G.s are shown in Figs. 1 and 2 and the E.C.G. of the animal with a serum Mg content of 0.6 mg. per cent. shows many more small fluctuations than that of the animal with a serum Mg content of 2.7 mg. per cent. The causes of these small fluctuations are the small contractions of the muscles, occurring as a result of the low serum Mg content, which in turn results in an increased irritability of the neuromuscular system (Engbaek, 1952) and Hutyra-Marek (1952).

Furthermore, the course of the line becomes much more even when the animal, part of whose E.C.G. is shown in Fig. 1, acquires a more normal serum Mg content five weeks later (Fig. 3), although the tops caused by the contractions of the heart not yet become much clearer. This is, however, the case 6 months later (Fig. 4).

The Experiment on 19th November, 1957

The 14 animals concerned had been tied up indoors for just over three weeks (since 25th October) when the E.C.G.s were taken for the second time, and the serum Mg content varied from 2.0 to 3.5 mg. per cent.; all had therefore returned to normal in that time (see Table I).

The pulse rates were a little higher than on the 14th October, due to the higher temperature of the surroundings. In November the E.C.G.s were taken indoors, in October out of doors, in an open shelter.

No correlation exists between the serum Mg content and the various data to be deducted from the E.C.G.s (see Table II). The correlation between the pulse rate and the duration of the PT-interval alone has now become clear. From this, and from the calculated partial correlation coefficients it can be deduced that the variation in the length of the intervals is now caused by the changes in pulse rate.

Further study of the data for the individual animals revealed, however, that the animals with the highest pulse rate were the same as those with the highest pulse rate on the 14th October.

For this reason the correlation between the pulse rate on 19th November and the serum Mg content on 14th October was calculated. This was $r = -0.49 \pm 0.20$ and therefore not significant; a certain connection may exist between both magnitudes.

The possibility is not excluded that the animals with the lowest serum Mg content have a higher pulse rate than the others; they may be more nervous, so that the fitting of the electrodes and placing on the isolated underlay had a stronger increasing influence on the pulse rate. It seems nevertheless more likely—also in view of the very significant correlation, found on 14th October, between serum Mg content and pulse rate — that the hearts of the animals suffered so much from a prolonged low serum Mg content, that they could not recover completely during the three weeks (approx.) that the serum Mg content was again normal. If this supposition is correct, this could have fairly far-reaching consequences in view of the frequent occurrence of hypomagnesaemia in cows (Kemp, 1958).

The correlation coefficient which were found between the pulse rate in November and the serum Mg content in October, were also calculated between the intervals of the E.C.G.s in November and the serum Mg content in October. These proved to be for the PR-interval: $r = +0.05$; for the RT-interval: $r = +0.56 \pm 0.18$ and for the PT-interval: $r = 0.27 + 0.20$. The connection between the serum Mg content in October and the duration of the RT-interval in November alone appeared to be significant.

It is probably no coincidence that of the correlation coefficients calculated in October, the one between RT-interval and serum Mg content was also greatest ($r = +0.90 \pm 0.053$). This correlation coefficient has decreased from which it may be deduced that the animals are recovering.

The Experiment on 29th April and 1st May, 1958

The data collected on 19th November, 1957, suggested that the heart function of those animals, which had a low serum Mg on the 14th October had not fully recovered after 3½ weeks indoors with normal feed. The E.C.G.s of the same animals were taken again approximately 6 months later, and 12 of them were taken on 29th April, 1958. The remaining two had been housed elsewhere, and in a slightly different atmosphere and their E.C.G.s were taken on 1st May, 1958. A summary of the data is also given in Table I, while Table II shows the calculated correlation coefficients. The serum Mg contents were normal in all animals and there is no reason to suppose that this differed during the winter season.

It is difficult to explain why the correlation coefficient between pulse rate and serum Mg content is greater now than in the beginning of the housing period (although the smaller spread of both factors influenced the outcome of the calculation).

The results described earlier enabled one to see how great the correlation coefficients were between the various factors deduced from the E.C.G.s at the end of the housing period, and the serum Mg content of the animals at the end of the previous grazing period.

For the pulse rate these proved to be: $r = -0.42 \pm 0.22$, approximately the same as in November. For the RT-interval: $r = +0.43 \pm 0.22$ and for the PT-interval: $r = +0.11 \pm 0.26$, both smaller than in November.

The values of these coefficients between pulse rate and RT-interval at the end of the housing period and the serum Mg content in October raise the question whether prolonged living with a low serum Mg content could perhaps result in more or less permanent damage to the heart. Two circumstances suggest an affirmative answer. The first is that the cow which had the highest pulse rate and the shortest RT-interval, continually had during the three periods (total 16 weeks) of Kemp's grazing experiment (1958), the lowest serum Mg content of all animals used in the experiment. The average serum Mg content of this cow in 20 observations was only 1.33 mg. per cent., while on 10 occasions the content was lower than 1 mg. per cent. and on 15 occasions lower than 2 mg. per cent.

The other support comes from the cow with the slowest pulse rate on 29th April, which is the animal whose serum Mg content was only once below 2 mg. per cent. ; this was in the beginning of 1957, and did not occur in the other animals. This cow's serum Mg content averaged 2.50 mg. per cent. for 20 observations.

It must be admitted that these findings in themselves do not provide proof and that fuller investigations will be necessary to be able to answer with certainty the question of the significance of prolonged hypomagnesaemia in relation to the functioning of the heart and perhaps also the longevity of dairy cattle.

Conclusions and Discussions

In the investigations described above it has been proved that there is a connection between the serum Mg content and certain characteristics of the E.C.G. It

appeared not only that animals living under the same climatic conditions had a faster pulse rate accordingly as the Mg content of the serum was lower ($r = -0.77 \pm 0.11$), but also that the duration of the RT- and PT-interval were shortened (correlation coefficients respectively $r = +0.90 \pm 0.5$ and $r = +0.79 \pm 0.10$).

Although the PR-interval also seems to be shorter with a low serum Mg content, no significant correlation existed between this magnitude and the serum Mg content ($r = +0.49 \pm 0.20$).

No connection was found between duration of QRS-interval and serum Mg content ; neither was the connection between the amplitudes and the Mg content of the serum obvious. After a good three weeks of normal feeding, during which all serum Mg. contents became normal, a certain restoration of the function of the heart can be observed. This restoration does not seem to be complete, as no clear correlation coefficients remained between serum Mg content and the various characteristics of the E.C.G.s, but they still existed between these last and the serum Mg content of four weeks previously.

The correlation coefficient between the duration of the RT-interval of six months later, during which time the serum Mg content had been normal, and the serum Mg content during the first observation was still $r = +0.43 \pm 0.22$, so that one is inclined to conclude that even a period of six months is not always sufficient to dispel the harmful influence of prolonged hypomagnesaemia.

As the number of cows available for the experiment was relatively small, and no E.C.G.s were taken before the grazing experiment was started, it is not possible to exclude the possibility that coincidence may have played an important role.

That there is a connection between the Mg content of the blood serum and certain characteristics of the E.C.G. was proved and this was further confirmed by some observations of four other cows. The data of these observations are given in Table V.

TABLE V

Cow	*Date*	*Serum Mg mg. %*	*Pulse /min.*	*PT 0.01 sec.*	*RT 0.01 sec.*	*RR 0.01 sec.*	*Bazett's constant*
A	21/5	2.4	76.0	44.3	29.6	78.9	0.333
	1/8	2.2	74.4	45.1	30.0	80.9	0.333
B	21/5	2.6	75.3	44.8	29.4	79.8	0.330
	1/8	2.1	69.9	48.7	32.0	85.9	0.325
C	21/5	1.7	88.9	39.6	27.6	67.5	0.337
	28/5	**0.4**	75.8	38.5	25.8	79.2	0.290
	1/8	1.5	74.8	42.0	28.0	80.1	0.314
D	21/5	1.2	82.4	45.6	28.4	72.8	0.334
	28/5	1.2	83.7	43.1	27.0	71.7	0.318
	1/8	1.4	71.9	46.3	28.1	83.5	0.309
	23/10*	0.7	65.7	44 8	29.4	91.5	0.306
	27/10	1.95	56.9	51.8	32.4	105.9	0.318

*E.C.G. very difficult to read, amplitudes very small.

From this it seems that the pulse rate is highest in animals with the lowest serum Mg content. They also usually have the shortest PT- and RT-interval. The data of one cow cannot be compared because the data were obtained under different climatic conditions; this influenced the pulse rate and therefore the intervals of the E.C.G.s. This is why the influence of the pulse rate on the duration of the RT-interval is eliminated by calculating Bazett's Constant. In cows *A* and *B*, which had a normal serum Mg content, this proved to fluctuate around 0.33. In Cow *C*, it is lowest when the serum Mg content is also lowest. In Cow *D*, the value of Bazett's constant is still normal when the serum Mg content has decreased to 1.2 mg. per cent., although a week later a decrease has started, which continues during the summer.

Feeding magnesium-cake to increase the serum Mg content to 1.95 mg. per cent. helps towards recovery, but four days is clearly too short for it to reach a normal level.

Finally, it should be mentioned that, although only the connection between serum Mg content and the various magnitudes of the E.C.G. of cattle was studied, it is not impossible that, together with changes in Mg content, the mineral composition of the blood did not remain constant, and this also influenced the E.C.G.s.

In an experiment by Sykes and Alfredson (1940), a K-shortage has a similar influence as a magnesium excess (Zwillinger 1935), and is it possible that in our experiment the changes in the E.C.G., brought about by magnesium deficiency, were accentuated by an increased K-content.

However, according to the results of an experiment in which the K-content did not fluctuate greatly (see Table VI), this influence will not have been very great.

TABLE VI

Cow	*Serum Mg. (mg. %)*	*Serum-K (mg. %)*
A	2.0	17.8
B	2.2	17.6
C	0.4	18.4
D	1.2	16.8

As further mineral composition of the blood was not determined, it is not possible to pass judgment. It would be useful if this received attention in any extension of this experiment, because the first experiment indicated that the significance of hypomagnesaemia does not restrict itself to the damage caused by grass tetany, but that the possibility exists that it is important for the longevity of dairy cattle, because prolonged hypomagnesaemia would have a harmful influence on the function of the heart.

Summary

By means of electrocardiograms the connection between serum Mg content and the heart function of dairy cattle has been investigated. Fourteen cows were used for this purpose and the serum Mg content originally varied from 0.6 to 2.8 mg. per 100 ml. Later, the E.C.G.s of the same animals were taken again; after

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5 weeks and 6½ months, while the serum Mg contents had fluctuated within the normal range. The conclusions to be drawn from this experiment are:

1. As the Mg content in the serum is lower, the pulse rate is higher (r pulse Mg $= -0.77 \pm 0.11$).

2. As the Mg content in the serum is lower, the RT- and PT-interval of the E.C.G. are shorter
(r RT Mg $= +0.90 \pm 0.05$ and r PT Mg $= +0.79 \pm 0.10$)

3. As the Mg content in the serum is lower, Bazett's constant $\frac{RT}{\sqrt{RR}}$ becomes smaller
($r \frac{RT}{\sqrt{RR}}$ Mg. $= +0.55 \pm 0.19$)

4. At the 2nd and 3rd observations (5 weeks and 6½ months later respectively) these correlation coefficients were no longer significant, but the correlation coefficient between duration of RT-interval at the 2nd observation, and serum Mg content at the first observation, was significant ($r = +0.56 \pm 0.18$).
The correlation coefficient between duration of RT-interval at the 3rd observation and serum Mg content at the first observation was $r = +0.43 \pm 0.22$.
These figures, as well as the correlation coefficients between pulse rate at the 2nd and 3rd observations and serum Mg content at the 1st observation, suggested that the prolonged low Mg content of the blood serum caused some damage of the heart and this organ recovers gradually. The number of observations is too small to draw this last conclusion with certainty.

5. The connection between serum Mg content and duration of PT- and QRS-interval was less clear.

6. There appeared to be no significant correlation between the extent of the amplitude (in mV) and the serum Mg content.

Acknowledgments

I would like to express my thanks to Dr. E. Brouwer for his important suggestions for this experiment, to the Institute for Biological and Chemical Research of Agricultural Crops at Wageningen for the use of animals suitable for this experiment, and for putting at my disposal the serum Mg results which had been determined there.

The team for "Physiology of work" of the Laboratory for Animal Physiology deserves a warm word of thanks for the help I experienced when taking the E.C.G.s.

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SPECIAL REPORT

ROYAL COLLEGE OF VETERINARY SURGEONS

A Special Meeting of Council was held on Monday, 16th May, 1960 to bestow the Diploma of Honorary Associate on Professor Dr. Rudolph-Rezsö Manninger. This is a very rare honour. Only about 25 living people, including Sir Winston Churchill, are Honorary Associates of the College. It was given in recognition of Professor Manninger's work as a teacher, writer and researcher in veterinary science. After welcoming the many guests that were present the President, Mr. J. N. Ritchie, said:

The Royal College of Veterinary Surgeons delights in its right to honour outstanding members of the veterinary profession wherever they may be working throughout the world. From time to time, but never without great care and consideration, it selects one or more names to be added to the list of distinguished men who have been chosen to receive the highest honour in the power of the College to bestow — election as an honorary associate of the College. Today we have met for one purpose only; to welcome Professor Manninger as our latest honorary associate. In doing so we add further distinction to an already distinguished roll of names.

It is always difficult to decide how much to say about a man who has made such a mark in his chosen profession. He is so well known that it is almost an insult to the audience to do more than outline the main achievements of a man who has spent a long and fruitful lifetime in service to mankind by his contributions to the understanding and control of animal disease. Professor Manninger, I believe, started his studies with the intention of becoming a biochemist. From there he developed an interest in serology and from that fascinating subject it is but a broadening of outlook and application to proceed to become an epidemiologist. What biochemistry lost was gained for that wide subject of epidemiology—a subject to which lip service is given by so many but which is understood and applied by so comparatively few.

Manninger is one of those hard-working men who, when the normal working day of teaching, research or field work is over for most people, devotes long hours to further study and writing. If he had done nothing but produce the various publications with which his name is associated we would be deeply in his debt. His writings, however, could not have been produced and would have been sterile and uninspired without his arduous training and experience in the widest field of veterinary activity and his close studies and critical appraisal of scientific literature, usually read in the original and certainly never in summary. His work has covered many diseases outstanding among which are swine fever, enterotoxæmia.

Ladies and gentlemen, we welcome a man today who stands at the highest peak of his profession, held in great esteem in his own country and in international veterinary circles alike. On this latter I can speak with considerable knowledge because Dr. Manninger and I have been colleagues in the Office International des Epizooties in Paris for some years. It was the accident of the alphabet that first brought us together for I have represented Great Britain while he has represented Hungary — this particular body arranges the seating for its delegates in alphabetical order. I feel confident, nevertheless that even if I had been representing Scotland, as some would think more appropriate, I would still have sought out Manninger to sit at his feet, to absorb some of his wisdom and to court and enjoy his friendship.

What makes a man like Manninger tick? How can a man work as hard as he does and still remain able to accept more work and more responsibility? Two

things mainly — the first is so very mundane — a good digestion: the second has rightly been placed above rubies — a good wife. We are so pleased to see Madame Manninger, here with her husband today.

Rudolph Manninger, I have the greatest possible pleasure in handing to you on behalf of the Royal College of Veterinary Surgeons this tangible evidence of the addition of your name to our list of distinguished men. In doing so may I offer you my own good wishes, the congratulations of the Royal College of Veterinary Surgeons and a hearty welcome to its honorary associateship. I wish you continued good health and contentment in the years ahead.

REVIEWS

MALADIES INFECTIEUSES DES ANIMAUX DOMESTIQUES. By Ch. van Goidsenhoven and F. Schoenaers. Paris: Vigot Frères; and Liége: S. A. Desoer. 852 pages.

The authors are professor emeritus and professor respectively at the State School of Veterinary Medicine, Cureghem-Bruxelles in Belgium. This text book is designed to provide basic information, including recent advances in our knowledge. The book is divided into two parts, the first dealing with diseases due to bacteria, and the second with diseases due to the viruses. Each disease is dealt with systematically under the headings:—Ætiology, Pathology, Symptomatology, Development, Prognosis, Diagnosis, Prophylaxis and Therapy. A list of references concludes the account of each disease.

There is an adequate index and the book is paper bound.

This text book will be most valuable to both under-graduates and graduates who can read French.

NEWS

A 3,800 BIRD TRIAL OF A NEW COCCIDIOSTAT

Large scale trials of Zoamix, a new coccidiostat introduced a year ago by Dow Agrochemicals Ltd. have been conducted in this country.

These results show that Zoamix, which is based on the drug Zoalene, has given high level control of coccidiosis, both caecal and intestinal, and has given better weight gains when compared with other coccidiostats administered as medicated feeds.

Trials were carried out by Dr. W. P. Blount, Chief Poultry Adviser and Director of B.O.C.M. Ltd., and by Mr. J. S. Scott, of the University of Oxford, Unit of Biometry.

Dr. Blount said "They began feeding trials at some of their demonstration farms where they were continuing to have annoying rather than serious outbreaks of caecal coccidiosis."

"Zoalene has given us almost complete freedom from this disease, both caecal and intestinal."

"When it was found that Zoalene, the active ingredient of Zoamix, appeared to be non-toxic at the recommended level, that it was able to keep coccidiosis at bay, did not depress the growth rate and was of no danger to the breeder, they plumped for it as the anti-coccidiosis drug to choose as a successor to nicarbazin."

It has now been fed to hundreds of thousands of broilers with complete success and used on farms also where formerly the history of coccidiosis was bad.

Details of the two trials are:—

3,800 Bird Trial by Broiler Experiments Ltd.:

Object of the experiment was to evaluate Zoamix in comparison with three other coccidiostats commonly used for continuous preventive protection against coccidiosis from the point of view of the effect on weight gains and food conversion.

The experiment involved 3,800 birds in 32 pens and was carried out in a single house, each pen containing 116 as-hatched birds. It lasted for 71 days concluding mid-February, 1960. Birds were fed from day old until slaughter with poultry food incorporating all coccidiostats at the recommended levels and supplied by B.O.C.M. Ltd. Each medication was replicated three times and there were four control pens in each of the two blocks.

DETAILS:

	*Tr.	Zo.	Ncb.	Ntf.	Control
Live weight in lbs.	3.76	3.92	2.81	3.67	3.74
Food consumption lbs. per surviving bird	9.75	9.84	9.61	9.28	9.70
Food conversion ratios	2.60	2.51	2.52	2.53	2.59

Relationship between live weight and food consumption

By statistical analysis it was found that the difference in live weight gained could not be accounted for wholly by the difference in food consumption. Figures arrived at showing live weight as a result of this analysis are as follows:—

	*Tr.	Zo.	Ncb.	Ntf.	Control
	3.74	3.90	3.82	3.71	3.74
Mortality:					
Pen averages					
per cent. dying	3.0	2.6	2.4	2.4	2.3
Average dead weight in lbs.					
Dead weight	3.34	3.35	3.31	3.25	3.29
Per cent. loss	11.2	13.8	13.1	11.4	12.0

Summing up the results, the researchers comment that "Zoamix gives a statistically significant increase in final live weight." The dead weights were exactly comparable to the live weights, that is to say the differences between the dead weights in each of the groups were exactly comparable with the differences in the live weights, hence the advantage given by Zoamix in liveweight gains was maintained in the dead weight.

*Tr.—Trithiadol. Zo.—Zoamix. Ncb.—Nicarbazin. Ntf.—Nitrofurazone.

Trials by B.O.C.M. Ltd.:

To compare body weight and feed conversion rates when different drugs were included in the feed:

Floor experiment to 10 weeks of age—300 chicks.

Ration	Weight Gain.	Feed Conversion		
	Av. Wt. (45-70 days) (lb.) lbs.	45-70 days	0-70 days	Point Spread
A. Hi-Gain Broiler Starter Mash containing Nicarbazin (0.015%)	3.02 1.43	3.04	2.60	42

B. Ditto, but with Nicarbazin (0.0125%)	3.13	1.51	3.16	2.60	53
C. Ditto, but with Zoamix (18 oz./ton)	3.16	1.50	3.08	2.53	63
D. Ditto, but with Trithiadol (2½ lb./ton)	2.89	1.41	3.07	2.59	30
% Improvement B over A	+3.64%	+5.59%	−3.49%	—	
% Improvement C over A	+4.64%	+4.90%	+1.32%	+2.69%	
% Improvement D over A	−4.30%	−1.40%	+0.99%	+0.38%	

Both research reports thus confirm for Great Britain the results of the University of Delaware trials of 1958** which show Zoamix as the best preparation giving coccidiostatic control with absence of all side effects as yet discovered. In the two Delaware experiments, which involved altogether 9,000 birds, counts were taken of the oocysts per gram of litter and the percentage of *Emira maxima* present, showing oocysts in the litter of all pens.

Up to 12 different coccidiostats were used and the point spread (the figure obtained by subtracting the feed conversion rate from the body weight) showed Zoamix to be considerably ahead of all other coccidiostats employed in both trials.

Federal Drug Administration of U.S.A. are satisfied that Zoalene is safe to use. It is now on the list of approved drugs in U.S.A.

It has been shown in recent short-term experiments that Zoamix controls also the two main species of coccidia affecting turkeys. As Zoamix is effective against turkey coccidia, then it is an extremely valuable agent, because so far only the sulphonamide drugs with their risk of serious side effects, including haemorrhagic troubles, have been at all effective.

" During the last two months V. W. Eves & Co. Ltd. of Hainault, Essex, have medicated with Zoamix sufficient supplements to produce over two million broilers —and report we have had no adverse comments about Zoamix."

**University of Delaware Agricultural Experiment Station, Newark, Delaware, U.S.A.

Progress Reports, Poultry Nutrition Report No. 4, August 13, 1958; Poultry Nutrition Report No. 5, December 4, 1958.

FOR WINNERS AND WORK DOGS

CRUFTS 1960. Supreme Champion Sulhamstead Merman. Owned by Mrs. F. Nagle and Miss M. Clark, this magnificent Irish Wolfhound was reared on Cod Liver Oil.

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Economical to buy and use, Super Solvitax Cod Liver Oil is pleasant tasting and mixes readily with normal diet. Improves appetite and feed conversion. Containing vital vitamins A and D, it has a high nutritive value, and is a natural source of energy.*

* This important factor makes Super Solvitax perfect for feeding to working dogs. In a survey on sheep dogs conducted in various parts of Britain, it was revealed that 39% had cod liver oil included in their diet.

★★★ Super Solvitax VETERINARY COD LIVER OIL

DAYKIN:
VETERINARY APPLIED PHARMACOLOGY and THERAPEUTICS

The need for a modern textbook of applied pharmacology has been apparent for some considerable time and in writing this book for the veterinary student (practitioners will also find it of interest and value) the author has drawn on his experience as a practitioner, a teacher, an examiner and a technical adviser.

The numbers and types of therapeutic agents have increased enormously and the older drugs have to be re-assessed in the light of modern knowledge. Structurally the book is divided into five sections in which information is provided on the essential physical, chemical, and pharmacological characteristics of all the important drugs now in veterinary use in Great Britain; details of actions and uses, toxicity, dosages, and methods of administration are given prominence. Special care has been taken to make clear exactly where the information given fits into the field of disease therapy.

This up-to-date textbook succeeds *Hoare's Veterinary Materia Medica and Therapeutics* and will, it is hoped, take the place of that standard textbook.

Contents

General Introduction : History, standard reference books, definitions of branches of learning and pharmacological phenomena.

Weights and measures. Prescription writing. Prescription building. Inscription, Subscription, Signature, Vegetable drugs.

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Alimentary System; Anthelmintics; Respiratory System; Heart and Circulatory System; Nervous System; Urinary System; Reproductive System; Agents affecting the Skin.

Chemotherapeutics

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Specific Therapeutics and Biologicals

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Pharmacy; Legal Obligations.

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